This listing of claims will replace all prior versions, listings, of claims in the application:

Listing of Claims:

1. (previously presented) A composite material, comprising:

a substrate having a surface relief pattern formed of surface features on a surface of the substrate including any of closed indentations, closed channels and open and continuous channels of selected size and shape, and a well ordered colloidal photonic crystal formed of colloidal particles of selected size and shape self-assembled within each of said surface features in the surface relief pattern, and each colloidal photonic crystal exhibiting optical Bragg diffraction.

2. (previously presented) The composite material according to claim 1 wherein said well ordered colloidal crystals formed by self-assembly of said colloidal particles are any one of a 2-D and 3-D colloidal photonic crystal.

3. (original) The composite material according to claim 2 wherein said substrate is selected from the group consisting of insulators, semiconductors, glasses, polymers and metals.

4. (original) The composite material according to claim 2 wherein said colloidal particles are spherical colloidal particles having a diameter in a range from about 0.1 to about 5 microns.

5. (previously presented) The composite material according to claim 4 wherein said spherical colloidal particles are one of silicon dioxide (SiO_2) and latex microspheres.

6. (original) The composite material according to claim 1 wherein said colloidal particles are consolidated by thermal sintering or hydrothermal treatment in aqueous base or silica chemical vapor deposition necking of the colloidal particles.

7. (original) The composite material according to claim 6 wherein said consolidated colloidal crystal is infiltrated with a material having a selected refractive index.

8. (original) The composite material according to claim 7 wherein said colloidal particles are removed producing an inverted infiltrated colloidal crystal embedded on said substrate.

9. (original) The composite material according to claim 8 wherein said inverted infiltrated colloidal crystal is a photonic crystal.

10. (original) The composite material according to claim 9 wherein said photonic crystal is characterized by a photonic bandgap.

11. (original) The composite material according to claim 9 including means for coupling light into said colloidal crystal or said inverted infiltrated colloidal crystal.

12. (original) The composite material according to claim 11 including means for coupling light out of said colloidal crystal said inverted infiltrated colloidal crystal.

13. (original) The composite material according to claim 12 wherein said means for coupling light into and out of said colloidal crystal are optical fibers and or waveguides attached to said substrate.

14. (original) The composite material according to claim 13 wherein said means for coupling light into and out of said colloidal crystal or said inverted colloidal crystal are optical fibers and or waveguides.

15. (original) The composite material according to claim 2 including a layer of a material formed on top of said colloidal crystal and said surface.

16. (original) The composite material according to claim 15 wherein said material is made of the substrate material so that said well ordered colloidal crystal is embedded in said substrate.

17. -86 (cancelled)

87. (previously presented) A composite material comprising a substrate having a surface relief pattern formed of surface features on a surface of the substrate including any of closed indentations, closed channels and open and continuous channels of selected size and shape, and a well ordered colloidal photonic crystal formed of colloidal particles of selected size and shape self-assembled within each of said surface features in the surface relief pattern, and each colloidal photonic crystal exhibiting optical Bragg diffraction, the composite material produced by a method comprising the steps of:

a) providing a substrate having a surface with a selected surface relief pattern;

b) applying masking means to a portion of said surface so that said masking means is resting on raised portions of said surface;

c) applying a liquid dispersion containing colloidal particles of selected shape and size to an unmasked portion of said surface wherein said colloidal particles are drawn under said masking means by capillary forces and self-assemble into a substantially ordered colloidal crystal in void spaces on said surface defined by said relief pattern and said masking means; and

d) removing said masking means.

88. (previously presented) A composite material comprising a substrate having a surface relief pattern formed of surface features on a surface of the substrate including any of closed indentations, closed channels and open and continuous channels of selected size and shape, and a well ordered colloidal photonic crystal formed of colloidal particles of selected size and shape self-assembled within each of said surface features in the surface relief pattern, and each colloidal photonic crystal exhibiting optical Bragg diffraction, the composite material produced by a method comprising the steps of:

a) providing a substrate having a surface with a selected surface relief pattern; and

b) applying a liquid dispersion containing colloidal particles of selected shape and size onto said surface and spinning said substrate whereby colloidal particles are swept across said surface and self-assemble in void spaces on said surface defined by said relief pattern.

89. (previously presented) A composite material comprising a substrate having a surface relief pattern formed of surface features on a surface of the substrate including any of closed indentations, closed channels and open and continuous channels of selected size and shape, and a well ordered colloidal photonic crystal formed of colloidal particles of selected size and shape self-assembled within each of said surface features in the surface relief pattern, and each colloidal photonic crystal exhibiting optical Bragg diffraction, the composite material produced by a method comprising the steps of:

a) providing a substrate having a surface with a selected surface relief pattern;

b) dipping said substrate into a liquid dispersion containing colloidal particles of selected shape and size, wherein said liquid dispersion includes a solvent having an effective evaporation rate, and wherein evaporation of said solvent induces directional mass transport of said colloidal particles within said relief pattern, wherein said colloidal particles spontaneously self-assemble and crystallize between raised features of said surface relief pattern; and

c) removing said substrate from said liquid dispersion.

90. (original) The product according to claim 89 wherein the method includes withdrawing said substrate from said liquid dispersion at a pre-selected rate.

91. (previously presented) A composite material, comprising a substrate having a surface relief pattern formed of surface features on a surface of the substrate including any of closed indentations, closed channels and open and continuous channels of selected size and shape, and a well ordered colloidal photonic crystal formed of colloidal particles of selected size and shape self-assembled within each of said surface features in the surface relief pattern, and each colloidal photonic crystal exhibiting optical Bragg diffraction, the composite material produced by a method comprising the steps of:

a) dipping a substrate into a liquid dispersion containing colloidal particles of selected shape and having a mean diameter in a range from about 600 nm to about 2500 nm, said liquid dispersion including a solvent having a pre-selected rate of evaporation;

b) agitating said liquid dispersion in such a way so as to reduce sedimentation of said colloidal particles but not to disturb a meniscus that is formed between the planar surface and the liquid dispersion of colloidal particles,

wherein evaporation of said solvent induces said colloidal particles to spontaneously self-assemble and crystallize on said planar surface; and

c) removing said substrate from said liquid dispersion.

92. (currently amended) A composite material comprised of a colloidal photonic crystal having photonic crystal regions of colloidal particles of different sizes and a substrate produced by a method comprising the steps of:

a) providing a substrate having a substantially planar top surface;

b) applying masking means to a portion of said top surface, said masking means having a surface with a first surface relief pattern with said surface being adjacent to said planar surface;

c) applying a dispersion containing first colloidal particles of selected shape and size to an unmasked portion of said top surface wherein said first colloidal particles are drawn under said masking means by capillary forces and form a first colloidal photonic crystal by self-assembly in void spaces between said surface and said masking means, the first colloidal photonic crystal exhibiting optical Bragg diffraction;

d) infiltrating a polymer into void spaces present between the colloidal particles in said first colloidal photonic crystal and curing said polymer;

e) removing said masking means wherein said colloidal crystal pattern on said substantially flat planar surface defines a second surface relief pattern having raised portions; and

f) applying a dispersion containing second colloidal particles of selected shape and size to said top surface wherein said second colloidal particles are drawn between said raised portions by capillary forces and form a second colloidal photonic crystal by self-assembly between said raised portions, wherein the second particles have a size different than a size of the first particles so that the second colloidal photonic crystal exhibits optical Bragg diffraction at a wavelength different from the first colloidal photonic crystal, and wherein said first colloidal particles are spherical colloidal particles having a first mean diameter, and wherein said second colloidal particles are spherical colloidal particles having a second mean diameter different from the first mean diameter.

93. (canceled)

94. (currently amended) The product according to claim ~~93~~ 92 wherein said product is characterized by a reflectance spectrum comprised of a first reflectance peak having a wavelength position and bandwidth determined by the diameter of said first spherical particles and a second reflectance peak having a wavelength position and bandwidth determined by the diameter of said second spherical particles.

95. (currently amended) The product according to claim ~~93~~ 92 wherein said first spherical particles have a diameter in a range from about 250 nm to about 600 nm, and wherein said second spherical particles have a diameter in a range from about 601 nm to about 2500 nm.

96. (currently amended) A bi-frequency colloidal crystal diffraction device, comprising:

a substrate and a first array of first colloidal particles of a first size arrayed in elongate, parallel and spaced first strips across a top surface of said substrate forming first colloidal photonic crystals in each of said first strips, and a second array of second colloidal particles of a second size arrayed in elongate, parallel and spaced second strips across ~~a~~ the top surface of said substrate with each second strip of said second array being located between two adjacent first strips of said first array forming second colloidal photonic crystals in each of said second strips, and wherein said first size is different from said second size, and wherein the first and second colloidal photonic crystals exhibit optical Bragg diffraction.

97. (original) The diffraction device according to claim 96 wherein said first colloidal particles are spherical colloidal particles having a first diameter and said second colloidal particles are spherical colloidal particles having a second diameter different from said first diameter, and wherein said device is characterized by a reflectance spectrum comprised of a first reflectance peak having a wavelength position and bandwidth determined by the diameter of said first spherical particles and a second reflectance peak having a wavelength position and bandwidth determined by the diameter of said second spherical particles.

98. (original) The diffraction device according to claim 97 wherein said first spherical particles have a diameter in a range from about 250 nm to about 600 nm, and wherein said second spherical particles have a diameter in a range from about 601 nm to about 2500 nm.

99. (currently amended) A ~~superlattice~~ photonic crystal structure, comprising:

a substrate and a first colloidal photonic crystal including an array of first colloidal particles of a first size arrayed in elongate, parallel and spaced strips across a top surface of said substrate, and a second colloidal photonic crystal including an array of second array of second colloidal particles of a second size arrayed in elongate, parallel and spaced strips over top of said first array and being disposed substantially perpendicular to said first array, the first and second colloidal photonic crystals exhibiting optical Bragg diffraction.

100. (currently amended) The ~~superlattice~~ photonic crystal structure according to claim ~~98~~ 99 wherein said first and second colloidal particles are spherical colloidal particles having a preselected diameter in a range from 250 nm to about 2500 nm.

101. (cancelled)

102. (previously presented) The product according to claim 92 wherein said first surface relief pattern includes first longitudinal channels, and wherein said second surface relief pattern having raised portions defines second longitudinal channels with said first longitudinal channels alternating with the second longitudinal channels.

103. (New) The product according to claim 92 wherein said first and second colloidal particles are spherical colloidal particles having a preselected diameter in a range from about 250 nm to about 2500 nm.

104. (New) The diffraction device according to claim 96 wherein said first and second colloidal particles are spherical colloidal particles having a preselected diameter in a range from about 250 nm to about 2500 nm.